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( Reaffirmed 1997 )

*Indian Standard*

# SPECIFICATION FOR 'O' RINGS

## PART 3 SEAL HOUSING DIMENSIONS, TOLERANCES AND DESIGN CRITERIA FOR STANDARD APPLICATIONS

Gaskets and Packings Sectional Committee, EDC 58, Oil Seals Subcommittee, EDC 58 : 3 [ Ref . Doc : EDC 58 ( 4212 ) ]

**1. Scope** — Covers 'O'-ring housing, dimensions and associated tolerances.

**1.1** Design criteria is based on elastomeric compounds of 70 IRHD, working at pressures up to 10 MPa and temperatures between −30°C and +100°C For other working conditions (pressures, temperature, etc) it may be necessary to select suitable elastomeric compounds of other hardnesses or to incorporate anti-extrusion rings.

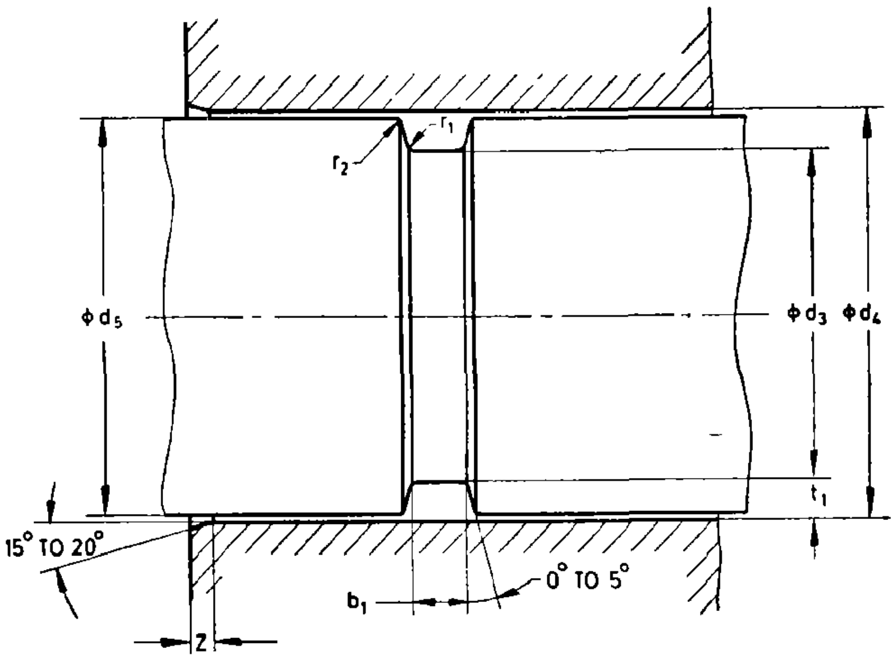

FIG 1

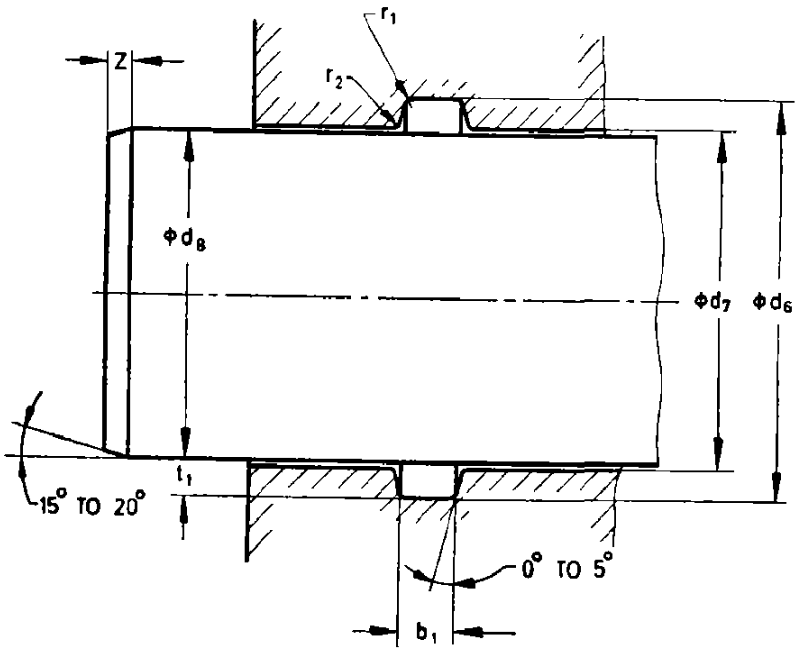

FIG. 2

| | | |
|---|---|---|
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## 2. Terminology

2 1 For the purpose of this standard the definitions given in IS : 9975 (Part 4)-1984 "Specification for 'O' rings Part 4 Terminology and definition of terms" shall apply

## 3. 'O'-Ring Housing Dimensions for Piston and Piston Rod Sealing

3 1 Table 1 (read with Fig 1 and 2) gives details of the range of component diameters within which each 'O'-ring according to IS 9975 (Part 1)-1981 "Specification for 'O' rings Part 1 Dimension" shall operate within specified design criteria, for example, 'O' ring squeeze, volume fill and stretch (or compression)

3 2 The 'O'-ring housing dimensions for piston and piston rod sealing arrangement are given in Table 2

### TABLE 1 'O'-RING HOUSING DIAMETERS (FOR PISTON AND PISTON ROD SEALING)

( *Clause* 3 1 and *Fig* 1 *and* 2 )

All dimensions in millimetres

| 'O'-Ring *Size Code* | Housing Diameter | | | |
|---|---|---|---|---|
| | $d_1$ | | $d_2$ | |
| | *Min* | *Max* | *Min* | *Max* |
| 18000800 | 11 05 | 11 19 | 8 16 | 8 29 |
| 850 | 11 55 | 11 79 | 8 62 | 8 79 |
| 900 | 12 06 | 12 26 | 9 09 | 9 28 |
| 950 | 12 56 | 12 80 | 9 55 | 9 78 |
| 1000 | 13 06 | 13 34 | 10 01 | 10 28 |
| 1060 | 13 67 | 13 97 | 10 86 | 10 87 |
| 1120 | 14 27 | 14 62 | 12 43 | 11 47 |
| 1180 | 14 88 | 15 26 | 12 00 | 12 06 |
| 1250 | 15 58 | 16 01 | 12 06 | 12 76 |
| 1320 | 16 28 | 16 77 | 13 32 | 13 46 |
| 1400 | 17 08 | 17 36 | 14 07 | 14 26 |
| 1500 | 18 09 | 18 41 | 15 02 | 15 26 |
| 1600 | 19 09 | 19 47 | 15 96 | 16 26 |
| 1700 | 20 10 | 20 52 | 16 91 | 17 26 |
| 26501400 | 18 54 | 18 74 | 14 25 | 14 42 |
| 1500 | 19 55 | 19 79 | 15 20 | 15 41 |
| 1600 | 20 55 | 20 85 | 16 14 | 16 41 |
| 1700 | 21 56 | 21 90 | 17 00 | 17 40 |
| 1800 | 22 56 | 22 96 | 18 03 | 18 41 |
| 1900 | 23 57 | 24 01 | 18 98 | 19 40 |
| 2000 | 24 57 | 25 07 | 19 92 | 20 40 |
| 2120 | 25 78 | 26 33 | 21 06 | 21 59 |
| 2240 | 26 99 | 27 59 | 22 19 | 22 78 |
| 2360 | 28 19 | 28 86 | 23 32 | 23 98 |
| 2500 | 29 60 | 30 34 | 24 65 | 25 37 |
| 2650 | 31 10 | 31 91 | 26 39 | 26 86 |
| 2800 | 32 62 | 33 48 | 27 83 | 28 34 |
| 3000 | 34 63 | 35 59 | 29 74 | 30 34 |
| 3150 | 36 15 | 37 16 | 31 19 | 31 82 |
| 3250 | 37 16 | 38 21 | 32 15 | 32 81 |
| 3350 | 38 16 | 39 27 | 33 10 | 33 81 |
| 3450 | 39 17 | 40 32 | 34 06 | 34 80 |
| 3550 | 40 18 | 41 37 | 35 02 | 35 79 |
| 3650 | 41 19 | 42 42 | 35 96 | 36 78 |
| 3750 | 42 20 | 43 47 | 36 94 | 37 77 |
| 3870 | 43 41 | 44 73 | 38 09 | 38 96 |
| 35501800 | 24 10 | 24 24 | 18 40 | 18 59 |
| 1900 | 25 11 | 25 29 | 19 35 | 19 58 |
| 2000 | 26 11 | 26 35 | 20 29 | 20 58 |
| 2120 | 27 32 | 27 61 | 21 43 | 21 77 |
| 2240 | 28 53 | 28 87 | 22 56 | 22 96 |
| 2360 | 29 73 | 30 14 | 23 69 | 24 16 |
| 2500 | 31 13 | 31 62 | 25 02 | 25 55 |
| 2650 | 32 64 | 33 19 | 26 78 | 27 04 |

( *Continued* )

# AMENDMENT NO. 1 MAY 1994
# TO
# IS 9975 (Part 3) : 1984 SPECIFICATION FOR 'O' RINGS
## PART 3 SEAL HOUSING DIMENSIONS, TOLERANCES AND DESIGN CRITERIA FOR STANDARD APPLICATIONS

( *Page* 14, *clause* A-3.1 ) — Substitute following for the existing clause.

**A-3.1** Selection of 'O' ring 53009000
size range 99.66 to 101.97 ( *see* Table 1 ).

( LMD 19 )

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**TABLE 1 'O'-RING HOUSING DIAMETERS (FOR PISTON AND PISTON ROD SEALING)** — *Contd*

| 'O'-Ring Size Code | Housing Diameter | | | |
|---|---|---|---|---|
| | $d_4$ | | $d_5$ | |
| | *Min* | *Max* | *Min* | *Max* |
| 2800 | 34·16 | 34 76 | 28 22 | 28 52 |
| 3000 | 36 17 | 36 87 | 30 14 | 30·52 |
| 3150 | 37 69 | 38 44 | 31·58 | 32·00 |
| 3250 | 38 70 | 39·49 | 32 54 | 32 99 |
| 3350 | 39 70 | 40 55 | 33 49 | 33·99 |
| 3450 | 40 71 | 41 60 | 34·45 | 34·98 |
| 3550 | 41 72 | 42 65 | 35·41 | 35·97 |
| 3650 | 42 73 | 43·70 | 36·37 | 36·96 |
| 3750 | 43 74 | 44 75 | 37·33 | 37 95 |
| 3870 | 44 95 | 46·01 | 38·48 | 39·14 |
| 4000 | 46 26 | 46·90 | 39·72 | 40 43 |
| 4120 | 47 47 | 48 23 | 40 87 | 41·62 |
| 4250 | 48·78 | 49 59 | 42 12 | 42·91 |
| 4370 | 49 98 | 50 83 | 43·26 | 44 10 |
| 4500 | 51 29 | 51·19 | 44 51 | 45·39 |
| 4620 | 52 50 | 53 44 | 45 66 | 46 50 |
| 4750 | 53 81 | 54 79 | 46·90 | 47 87 |
| 4870 | 55·02 | 56·04 | 48·05 | 49·06 |
| 5000 | 56 33 | 57 40 | 49 30 | 50 36 |
| 5150 | 57 84 | 58 96 | 50·74 | 51 85 |
| 5300 | 59 35 | 60 53 | 52·17 | 53 34 |
| 5450 | 60 87 | 62 08 | 53·62 | 54 82 |
| 5600 | 62·38 | 63 64 | 55·05 | 56 31 |
| 5800 | 64·39 | 65 73 | 56·96 | 58 30 |
| 6000 | 66 41 | 67 81 | 58 88 | 60·28 |
| 6150 | 67 92 | 69 38 | 61·01 | 61 77 |
| 6300 | 69 43 | 70 94 | 62 46 | 63·26 |
| 6500 | 71 45 | 73·02 | 64 39 | 65 24 |
| 6700 | 73 46 | 75·11 | 66 32 | 67 20 |
| 6900 | 75 48 | 77 19 | 68 26 | 69·21 |
| 7100 | 77 50 | 79 27 | 70 20 | 71 19 |
| 7300 | 79 51 | 81 36 | 72 13 | 73 18 |
| 7500 | 81 53 | 83 44 | 74 87 | 75 16 |
| 7750 | 84 04 | 86·05 | 76 48 | 77 65 |
| 8000 | 86 56 | 88 66 | 78·90 | 80 14 |
| 8250 | 89 08 | 91 26 | 81 33 | 82 62 |
| 8500 | 91 60 | 93 86 | 83 74 | 85·10 |
| 8750 | 94 12 | 96 47 | 86 16 | 87·58 |
| 9000 | 96 64 | 99·07 | 88 58 | 90·06 |
| 9250 | 99 16 | 101 68 | 91 00 | 92 54 |
| 9500 | 101 68 | 104 28 | 93 42 | 95 02 |
| 9750 | 104 20 | 106 88 | 95 84 | 97·50 |
| 35510000 | 106 71 | 108 51 | 98 25 | 99·99 |
| 10300 | 109 74 | 111 60 | 101 16 | 102·96 |
| 10600 | 112·76 | 114·69 | 104 60 | 105·94 |
| 10900 | 115 78 | 117 79 | 106·96 | 108·92 |
| 11200 | 118 80 | 120 89 | 109 86 | 111 90 |
| 11500 | 121 81 | 123 99 | 112 76 | 114 88 |
| 11800 | 124 83 | 127 09 | 115·66 | 117·86 |
| 12200 | 128 86 | 131 22 | 119·52 | 121·84 |
| 12500 | 131 89 | 134 31 | 122 44 | 124 81 |
| 12800 | 134·91 | 137 41 | 126·70 | 127 79 |
| 13200 | 138 94 | 141 54 | 130 61 | 131 76 |
| 13600 | 142 96 | 145·68 | 134 51 | 135 74 |
| 14000 | 146 99 | 149·80 | 138·42 | 139·71 |
| 14500 | 152 03 | 154·96 | 143·31 | 144 67 |
| 15000 | 157 06 | 160 13 | 148·19 | 149 64 |
| 15500 | 162 10 | 165·29 | 153·08 | 154·60 |
| 16000 | 167·13 | 170 46 | 157 96 | 159 57 |
| 16500 | 172·17 | 175 62 | 162·84 | 164·53 |
| 17000 | 177·20 | 180 79 | 167·72 | 169·50 |
| 17500 | 182·23 | 185·94 | 172 61 | 174·46 |
| 18000 | 187·26 | 191·11 | 177·49 | 179·43 |
| 18600 | 192 29 | 196·28 | 182·38 | 184·42 |
| 19000 | 197 33 | 201 44 | 187·27 | 189 38 |

( *Continued* )

TABLE 1 'O'-RING HOUSING DIAMETERS (FOR PISTON AND PISTON ROD SEALING) — *Contd*

| 'O'-Ring Size Code | Housing Diameter | | | |
|---|---|---|---|---|
| | $d_4$ | | $d_6$ | |
| | *Min* | *Max* | *Min* | *Max* |
| 19500 | 202·36 | 206·61 | 192·15 | 194·35 |
| 20000 | 207·40 | 211·77 | 197·03 | 199·31 |
| 53004000 | 49·28 | 49·88 | 40·10 | 40·75 |
| 4120 | 50·48 | 51·13 | 41·25 | 41·94 |
| 4250 | 51·79 | 52·49 | 42·50 | 43·23 |
| 4370 | 53·00 | 53·73 | 43·65 | 44·42 |
| 4500 | 54·31 | 55·09 | 44·89 | 45·71 |
| 4620 | 55·52 | 56·34 | 46·04 | 46·90 |
| 4750 | 56·89 | 57·69 | 47·29 | 48·19 |
| 4870 | 58·04 | 58·74 | 48·43 | 49·38 |
| 5000 | 59·35 | 60·30 | 49·68 | 50·68 |
| 5150 | 60·86 | 61·86 | 51·12 | 52·17 |
| 5300 | 62·37 | 63·43 | 52·55 | 53·66 |
| 5450 | 63·89 | 64·98 | 54·00 | 55·14 |
| 5600 | 65·40 | 66·54 | 55·43 | 56·63 |
| 5800 | 67·41 | 68·73 | 57·34 | 58·62 |
| 6000 | 69·43 | 70·71 | 59·26 | 60·60 |
| 6150 | 70·94 | 72·28 | 61·42 | 62·09 |
| 6300 | 72·45 | 73·84 | 62·87 | 63·58 |
| 6500 | 74·47 | 75·92 | 64·81 | 65·56 |
| 6700 | 76·48 | 78·01 | 66·74 | 67·55 |
| 6900 | 78·50 | 80·09 | 68·68 | 69·53 |
| 7100 | 80·52 | 82·17 | 70·62 | 71·51 |
| 7300 | 82·53 | 84·26 | 72·55 | 73·50 |
| 7500 | 84·55 | 86·34 | 74·49 | 75·48 |
| 7750 | 87·06 | 88·95 | 76·90 | 77·97 |
| 8000 | 89·58 | 91·56 | 79·32 | 80·46 |
| 8250 | 92·10 | 94·16 | 81·74 | 82·94 |
| 8500 | 94·62 | 96·76 | 84·16 | 85·42 |
| 8750 | 97·14 | 99·37 | 86·58 | 87·90 |
| 9000 | 99·66 | 101·97 | 89·00 | 90·38 |
| 9250 | 102·18 | 104·58 | 91·42 | 92·86 |
| 9500 | 104·70 | 107·18 | 93·84 | 95·34 |
| 9750 | 107·22 | 109·78 | 96·26 | 97·82 |
| 53010000 | 109·73 | 111·41 | 98·67 | 100·31 |
| 10300 | 112·76 | 114·50 | 101·58 | 103·28 |
| 10600 | 115·78 | 117·59 | 104·48 | 106·26 |
| 10900 | 118·80 | 120·69 | 107·38 | 109·24 |
| 11200 | 121·81 | 123·79 | 110·27 | 112·22 |
| 11500 | 124·83 | 126·69 | 113·17 | 115·20 |
| 11800 | 127·85 | 129·99 | 116·07 | 118·18 |
| 12200 | 131·88 | 134·12 | 119·94 | 122·14 |
| 12500 | 134·91 | 137·21 | 122·26 | 125·13 |
| 12800 | 137·93 | 140·31 | 127·16 | 128·11 |
| 53013200 | 141·96 | 144·44 | 131·06 | 132·08 |
| 13600 | 145·98 | 148·58 | 134·96 | 136·06 |
| 14000 | 150·01 | 152·70 | 138·87 | 140·04 |
| 14500 | 155·05 | 157·86 | 143·76 | 144·99 |
| 15000 | 160·08 | 163·03 | 148·64 | 149·94 |
| 15500 | 165·12 | 168·19 | 153·53 | 154·92 |
| 16000 | 170·15 | 173·36 | 158·41 | 159·89 |
| 16500 | 175·19 | 178·52 | 163·30 | 164·85 |
| 17000 | 180·21 | 183·69 | 168·18 | 169·82 |
| 17500 | 185·25 | 188·84 | 173·07 | 174·78 |
| 18000 | 190·28 | 194·01 | 177·94 | 179·75 |
| 18500 | 195·31 | 199·18 | 182·83 | 184·74 |
| 19000 | 200·35 | 204·34 | 187·72 | 189·70 |
| 19500 | 205·38 | 209·51 | 192·60 | 194·67 |
| 20000 | 210·42 | 214·67 | 197·49 | 199·63 |
| 20600 | 216·46 | 218·82 | 203·35 | 205·59 |
| 21200 | 222·50 | 224·96 | 209·21 | 211·55 |
| 21800 | 228·54 | 231·10 | 215·06 | 217·51 |
| 22400 | 234·50 | 237·24 | 220·92 | 223·47 |

( *Continued* )

**TABLE 1 'O'-RING HOUSING DIAMETERS (FOR PISTON AND PISTON ROD SEALING)** — *Contd*

| 'O'-Ring Size Code | Housing Diameter | | | |
|---|---|---|---|---|
| | $d_4$ | | $d_8$ | |
| | *Min* | *Max* | *Min* | *Max* |
| 23000 | 240·62 | 243·38 | 226·78 | 229·43 |
| 23600 | 246·66 | 249·52 | 232·64 | 235·39 |
| 24300 | 253·69 | 256·09 | 239·47 | 242·35 |
| 25000 | 260·74 | 263·84 | 246·31 | 249·30 |
| 25800 | 268·79 | 272·03 | 256·83 | 257·26 |
| 26500 | 275·84 | 279·19 | 263·74 | 264·21 |
| 27200 | 282·88 | 286·36 | 270·64 | 271·17 |
| 28000 | 290·94 | 294·54 | 278·54 | 279·11 |
| 29000 | 301·00 | 304·78 | 288·40 | 289·05 |
| 30000 | 311·07 | 315·00 | 298·26 | 298·90 |
| 30700 | 318·10 | 322·17 | 305·16 | 305·94 |
| 31500 | 326·15 | 330·36 | 313·05 | 313·89 |
| 32500 | 336·22 | 340·59 | 322·93 | 323·80 |
| 33500 | 346·28 | 350·83 | 332·79 | 333·77 |
| 34500 | 356·34 | 361·06 | 342·65 | 343·70 |
| 35500 | 366·41 | 371·29 | 352·51 | 353·64 |
| 36500 | 376·47 | 381·53 | 362·37 | 363·58 |
| 37500 | 384·56 | 391·77 | 372·23 | 373·52 |
| 38700 | 398·01 | 404·03 | 384·07 | 385·48 |
| 40000 | 411·68 | 417·35 | 396·89 | 398·36 |
| 70020600 | 219·62 | 221·78 | 203·62 | 205·89 |
| 21200 | 225·46 | 227·93 | 209·48 | 211·85 |
| 21800 | 231·50 | 234·06 | 215·34 | 217·81 |
| 22400 | 237·34 | 240·20 | 221·20 | 223·77 |
| 23000 | 243·58 | 246·34 | 227·06 | 229·73 |
| 23600 | 249·62 | 252·48 | 232·92 | 235·69 |
| 24300 | 256·65 | 259·65 | 239·75 | 242·65 |
| 25000 | 265·70 | 267·87 | 248·77 | 249·60 |
| 25800 | 271·75 | 274·99 | 257·14 | 257·56 |
| 26500 | 278·80 | 282·15 | 264·05 | 264·51 |
| 27200 | 285·84 | 289·32 | 270·95 | 271·47 |
| 28000 | 293·90 | 299·50 | 278·85 | 279·41 |
| 29000 | 304·96 | 307·74 | 288·71 | 289·33 |
| 30000 | 314·05 | 312·96 | 298·58 | 299·28 |
| 30700 | 321·06 | 325·13 | 305·40 | 306·24 |
| 31500 | 329·11 | 333·32 | 313·36 | 314·19 |
| 32500 | 339·18 | 343·55 | 323·24 | 324·13 |
| 33500 | 349·24 | 353·79 | 333·10 | 334·07 |
| 34500 | 359·30 | 360·03 | 342·96 | 344·01 |
| 35500 | 369·37 | 374·25 | 352·82 | 353·94 |
| 36500 | 379·43 | 384·49 | 362·68 | 363·88 |
| 37500 | 389·49 | 394·13 | 372·54 | 373·82 |
| 38700 | 401·56 | 406·16 | 384·38 | 385·74 |
| 40000 | 414·64 | 419·31 | 397·20 | 398·66 |
| 41200 | 426·71 | 428·51 | 409·03 | 410·60 |
| 42500 | 439·79 | 441·69 | 421·85 | 423·52 |
| 43700 | 451·87 | 453·85 | 433·69 | 435·44 |
| 45000 | 464·35 | 467·03 | 446·51 | 448·86 |
| 46200 | 477·02 | 479·20 | 458·34 | 468·29 |
| 47500 | 490·10 | 492·37 | 471·16 | 473·21 |
| 48700 | 502·16 | 504·54 | 482·90 | 485·14 |
| 50000 | 515·24 | 517·72 | 495·80 | 498·06 |
| 51500 | 530·33 | 532·93 | 510·60 | 512·99 |
| 53000 | 542·42 | 548·14 | 523·39 | 527·9[illegible] |
| 54500 | 560·51 | 563·35 | 540·18 | 542·81 |
| 56000 | 575·60 | 578·55 | 554·90 | 557·72 |
| 58000 | 596·77 | 598·83 | 574·60 | 577·60 |
| 60000 | 615·84 | 619·11 | 594·40 | 597·48 |
| 61500 | 630·91 | 634·33 | 609·18 | 612·40 |
| 63000 | 646·00 | 649·54 | 623·97 | 627·31 |
| 65000 | 666·12 | 669·81 | 643·69 | 647·20 |
| 67000 | 686·24 | 690·09 | 663·40 | 667·08 |

TABLE 2 'O'-RING HOUSING DIMENSIONS FOR PISTON AND PISTON ROD SEALING

( *Clause* 3.2 and *Fig* 1 *and* 2 )

All dimensions in millimetres.

| 'O'-Ring Cross Section Diameter $d_2$(mm) | Housing Width $b_1$ (mm) $+0·25$ $-0·00$ | Housing Radial Depth $t_1$(mm) | | Maximum Diametral Clearance $C$ | Corner Radii $r_1$ | Edges Radii $r_2$ |
|---|---|---|---|---|---|---|
| | | Piston Housing | Piston Rod Housing | | | |
| 1·80 | 2·4 | 1 38 | 1 42 | 0·13 | 0.5 | 0 1/0 3 |
| 2·65 | 3 6 | 2·07 | 2 15 | 0·13 | 0 5 | 0·1/0 3 |
| 3·55 | 4·8 | 2·74 | 2 85 | 0·15 | 1·0 | 0·2/0 4 |
| 5·30 | 7·1 | 4 19 | 4·36 | 0·18 | 1·0 | 0·2/0 4 |
| 7 00 | 9·5 | 5 67 | 5 89 | 0 20 | 1·0 | 0·2/0 4 |

**Note** — Housing sizes given are suitable for pressures up to and including 10 MPa.

3.3 *Diametral Clearance* — The maximum diametral clearance (*C*) given in Table 2 is suitable only for the compound (70 IRHD) under consideration and for pressures up to and including 10 MPa.

3.3.1 However since increased compound hardness, back up rings (or) reduced clearances (or) both promote sealing to much greater pressures, the seal manufacturer may be consulted for recommended diametral clearances for compounds of different hardness values and varying pressures

3.4 *Lead-in-Chamfers — The length of lead-in-chamfer (Z) as shown in Table 3 is provided in cylinder* bore of piston housing and in piston rod of piston rod housing

TABLE 3 LEAD-IN-CHAMEFRS

All dimensions in millimetres

| 'O' Ring Cross Section Diameter, $d_2$ | 1·80 | 2 65 | 3 55 | 5 30 | 7 00 |
|---|---|---|---|---|---|
| Lead 'Z', *Min* | 1 1 | 1·5 | 1 8 | 2 7 | 3 6 |

3.5 *Method of Calculating Housing Dimensions for Static Radial Applications*

Piston rod housing (*see* Fig 2)

$d_6$ *Min* = $d_5$ *Max* + $2t$

Piston housing ( *see* Fig 1 ).

$d_3$ *Max* = $d_4$ *Min* $- 2t_1$

Examples are shown in Appendix A.

## 4. 'O' Ring Housing Dimensions for Axial Sealing

**4.1** The recommended housing dimensions of 'O' ring for axial sealing are given in Tables 4 and 5 read with Fig 3A and 3B

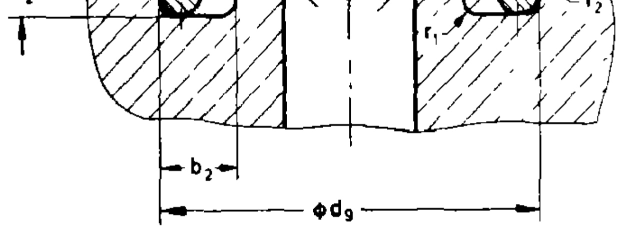


FIG. 3A

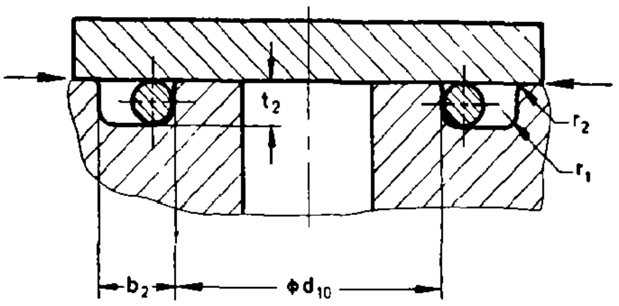


FIG 3B

## TABLE 4 'O' RING HOUSING DIAMETER FOR AXIAL SEALING ( STATIC )

( *Clause* 4·1 and *Fig* 3A *and* 3B )

All dimensions in millimetres

| 'O'-Ring Size Code | Housing $d_9$ | Nominal Diameter $d_{10}$ |
|---|---|---|
| 18000800 | 11·60 | 8·00 |
| 850 | 12·10 | 8·50 |
| 900 | 12·60 | 9·00 |
| 950 | 13·10 | 9·50 |
| 1000 | 13·60 | 10·00 |
| 1060 | 14·20 | 10·60 |
| 1120 | 14·60 | 11·20 |
| 1180 | 15·40 | 11·80 |
| 1250 | 16·10 | 12·50 |
| 1320 | 16·80 | 13·20 |
| 1400 | 17·60 | 14·00 |
| 1500 | 18·60 | 15·00 |
| 1600 | 19·60 | 16·00 |
| 1700 | 20·60 | 17·00 |
| 26501400 | 19·30 | 14·00 |
| 1500 | 20·30 | 15·00 |
| 1600 | 21·30 | 16·00 |
| 1700 | 22·30 | 17·00 |
| 1800 | 23·30 | 18·00 |
| 1900 | 24·30 | 19·00 |
| 2000 | 25·30 | 20·00 |
| 2120 | 26·50 | 21·20 |
| 2240 | 27·70 | 22·40 |
| 2360 | 28·90 | 23·60 |
| 2500 | 30·30 | 25·00 |
| 2650 | 31·80 | 26·50 |
| 2800 | 33·30 | 28·00 |
| 3000 | 35·30 | 30·00 |
| 3150 | 36·80 | 31·50 |
| 3250 | 37·80 | 32·50 |
| 3350 | 38·80 | 33·50 |
| 3450 | 39·80 | 34·50 |
| 3550 | 40·80 | 35·50 |
| 3650 | 41·80 | 36·50 |
| 3750 | 42·80 | 37·50 |
| 3870 | 44·00 | 38·70 |
| 35501800 | 25·10 | 18·00 |
| 1900 | 26·10 | 19·00 |
| 2000 | 27·10 | 20·00 |
| 2120 | 28·30 | 21·20 |
| 2240 | 29·50 | 22·40 |
| 2360 | 30·70 | 23·60 |
| 2500 | 32·10 | 25·00 |
| 2650 | 33·60 | 26·50 |
| 2800 | 35·10 | 28·00 |
| 3000 | 37·10 | 30·00 |

( *Continued* )

TABLE 4 'O' RING HOUSING DIAMETER FOR AXIAL SEALING (STATIC) — *Contd*

| 'O'-Ring Size Code | Housing | Nominal Diameter |
|---|---|---|
| | $d_9$ | $d_{10}$ |
| 3150 | 38·60 | 31·50 |
| 3250 | 39·60 | 32·50 |
| 3350 | 40·60 | 33·60 |
| 3450 | 41·60 | 34·5 |
| 3550 | 42·60 | 35·5 |
| 3650 | 43·60 | 36·5 |
| 3750 | 44·60 | 37·5 |
| 3870 | 45·80 | 38·7 |
| 4000 | 47·10 | 40·0 |
| 4120 | 48·30 | 41·2 |
| 4250 | 49·60 | 42·50 |
| 4370 | 50·80 | 43·70 |
| 4500 | 52·10 | 45·0 |
| 4620 | 53·80 | 46·2 |
| 4750 | 54·60 | 47·5 |
| 4870 | 55·80 | 48·7 |
| 5000 | 57·10 | 50·0 |
| 5150 | 58·60 | 51·5 |
| 5300 | 60·10 | 53·0 |
| 5450 | 61·60 | 54·5 |
| 5600 | 63·10 | 56·0 |
| 5800 | 65·10 | 58·00 |
| 6000 | 67·10 | 60·0 |
| 6150 | 68·60 | 61·5 |
| 6300 | 70·10 | 63·0 |
| 6500 | 72·10 | 65·0 |
| 6700 | 74·10 | 67·0 |
| 6900 | 76·10 | 69·0 |
| 7100 | 78·10 | 71·0 |
| 7300 | 80·10 | 73·0 |
| 7500 | 82·10 | 75·0 |
| 7750 | 84·60 | 77·5 |
| 8000 | 87·10 | 80·0 |
| 8250 | 89·60 | 82·5 |
| 8500 | 92·10 | 85·0 |
| 8750 | 94·60 | 87·5 |
| 9000 | 97·10 | 90·0 |
| 9250 | 99·60 | 92·5 |
| 9500 | 102·10 | 95·0 |
| 9750 | 104·60 | 97·5 |
| 10000 | 107·10 | 100 |
| 10300 | 110·10 | 103 |
| 10600 | 113·10 | 106 |
| 10900 | 116·10 | 109 |
| 11200 | 119·10 | 112 |
| 11500 | 122·10 | 115 |
| 11800 | 125·10 | 118 |
| 12200 | 129·10 | 122 |
| 12500 | 132·10 | 125 |
| 35512800 | 135·10 | 128 |
| 13200 | 139·10 | 132 |
| 13600 | 143·10 | 136 |
| 14000 | 147·10 | 140 |
| 14500 | 152·10 | 145 |
| 15000 | 157·10 | 150 |
| 15500 | 162·10 | 155 |
| 16000 | 167·10 | 160 |
| 16500 | 172·10 | 165 |
| 17000 | 177·10 | 170 |
| 17500 | 182·10 | 175 |
| 18000 | 187·10 | 180 |
| 18500 | 192·10 | 185 |
| 19000 | 197·10 | 190 |
| 19500 | 202·10 | 195 |
| 35520000 | 207·10 | 200 |
| 53004000 | 50·60 | 40·0 |
| 4120 | 51·80 | 41·2 |
| 4250 | 53·10 | 42·5 |

*( Continued )*

TABLE 4 'O' RING HOUSING DIAMETER FOR AXIAL SEALING (STATIC) — *Contd*

| 'O'-Ring Size Code | Housing | Nominal Diameter |
|---|---|---|
| | $d_9$ | $d_{10}$ |
| 4370 | 54·30 | 43·7 |
| 4500 | 55·60 | 45·0 |
| 4620 | 56·80 | 46·2 |
| 4750 | 58·10 | 47·5 |
| 4870 | 59·30 | 48·7 |
| 5000 | 60·60 | 50·0 |
| 5150 | 62·10 | 51·5 |
| 5300 | 63·60 | 53·0 |
| 5450 | 65·10 | 54·5 |
| 5600 | 66·60 | 56·0 |
| 5800 | 68·60 | 58·0 |
| 6000 | 70·60 | 60·0 |
| 6150 | 72·10 | 61·5 |
| 6300 | 73·60 | 63·0 |
| 6500 | 75·60 | 65·0 |
| 6700 | 77·60 | 67·0 |
| 6900 | 79·60 | 69·0 |
| 7100 | 81·60 | 71·0 |
| 7300 | 83·60 | 73·0 |
| 7500 | 85·60 | 75·0 |
| 7750 | 88·10 | 77·5 |
| 8000 | 90·60 | 80·0 |
| 8250 | 93·10 | 82·5 |
| 8500 | 95·60 | 85·0 |
| 8750 | 98·10 | 87·5 |
| 9000 | 100·60 | 90·0 |
| 9250 | 103·10 | 92·5 |
| 9500 | 105·60 | 95·0 |
| 9750 | 108·10 | 97·5 |
| 53010000 | 110·60 | 100 |
| 10300 | 113·60 | 103 |
| 10600 | 116·60 | 106 |
| 10900 | 119·60 | 109 |
| 11200 | 122·60 | 112 |
| 11500 | 125·60 | 115 |
| 11800 | 128·60 | 118 |
| 12200 | 132·00 | 122 |
| 12500 | 135·60 | 125 |
| 12800 | 138·60 | 128 |
| 13200 | 142·60 | 132 |
| 13600 | 146·60 | 136 |
| 14000 | 150·00 | 140 |
| 53014500 | 155·60 | 145 |
| 15000 | 160·60 | 150 |
| 15500 | 165·60 | 155 |
| 16000 | 170·60 | 160 |
| 16500 | 175·60 | 165 |
| 17000 | 180·60 | 170 |
| 17500 | 185·60 | 175 |
| 18000 | 190·60 | 180 |
| 18500 | 195·60 | 185 |
| 19000 | 200·60 | 190 |
| 19500 | 205·60 | 195 |
| 53020000 | 210·60 | 200 |
| 20600 | 216·60 | 206 |
| 21200 | 222·60 | 212 |
| 21800 | 228·60 | 218 |
| 22400 | 234·60 | 224 |
| 23000 | 240·60 | 230 |
| 23600 | 246·60 | 236 |
| 24300 | 253·60 | 243 |
| 25000 | 260·60 | 250 |
| 25800 | 268·60 | 258 |
| 26500 | 275·00 | 265 |
| 27200 | 282·60 | 272 |
| 28000 | 290·60 | 280 |
| 29000 | 300·60 | 290 |
| 30000 | 310·60 | 300 |

( *Continued* )

## TABLE 4 'O'-RING HOUSING DIAMETER FOR AXIAL SEALING (STATIC) — *Contd*

| 'O'-Ring Size Code | Housing | Nominal Diameter |
|---|---|---|
| | $d_9$ | $d_{10}$ |
| 30700 | 317·60 | 307 |
| 31500 | 325·60 | 315 |
| 32500 | 335·60 | 325 |
| 33500 | 345·60 | 335 |
| 34500 | 355 60 | 345 |
| 35500 | 365·60 | 355 |
| 36500 | 375·60 | 365 |
| 37500 | 385·60 | 375 |
| 38700 | 397·60 | 387 |
| 53040000 | 410·60 | 400 |
| 70020600 | 220 | 206 |
| 21200 | 226 | 212 |
| 21800 | 232 | 218 |
| 22400 | 238 | 224 |
| 23000 | 244 | 230 |
| 23600 | 250 | 236 |
| 24300 | 257 | 243 |
| 25000 | 264 | 250 |
| 25800 | 272 | 258 |
| 26500 | 279 | 265 |
| 27200 | 286 | 272 |
| 28000 | 294 | 280 |
| 29000 | 304 | 290 |
| 30000 | 314 | 300 |
| 30700 | 321 | 307 |
| 31500 | 329 | 315 |
| 32500 | 339 | 325 |
| 70033500 | 349 | 335 |
| 34500 | 359 | 345 |
| 35500 | 369 | 355 |
| 36500 | 379 | 365 |
| 37500 | 389 | 375 |
| 38700 | 401 | 387 |
| 40000 | 414 | 400 |
| 41200 | 426 | 412 |
| 42500 | 439 | 425 |
| 43700 | 451 | 437 |
| 45000 | 464 | 450 |
| 46200 | 476 | 462 |
| 47500 | 489 | 475 |
| 48700 | 501 | 487 |
| 50000 | 514 | 500 |
| 51500 | 529 | 515 |
| 53000 | 544 | 530 |
| 54500 | 559 | 545 |
| 56000 | 574 | 560 |
| 58000 | 594 | 580 |
| 60000 | 614 | 600 |
| 61500 | 629 | 615 |
| 63000 | 644 | 630 |
| 65000 | 664 | 650 |
| 67000 | 684 | 670 |

## TABLE 5 'O'-RING HOUSING DIMENSIONS FOR AXIAL SEALING

( *Clause* 4.1 and Fig. 3A *and* 3B )

All dimensions in millimetres.

| 'O'-Ring Cross Diameter $d_2$ | Housing Depth $t_2$ | Housing Width $b_2$ | Corner Radii $r_1$ | Edge Radii $r_2$ |
|---|---|---|---|---|
| 1·80 | 1 28 | 2·6 | 0 5 | 0·1-0·3 |
| 2·65 | 1·97 | 3·8 | 0·5 | 0·1-0 3 |
| 3·55 | 2·75 | 5·0 | 1·0 | 0·2-0 4 |
| 5·30 | 4·24 | 7·3 | 1·0 | 0·2-0·4 |
| 7·00 | 5·72 | 9·7 | 1 0 | 0·2-0·4 |

**4.2** Method of calculating housing dimensions for axial sealing (static) application:

$d_9$ nominal = $d_1$ nominal + 2 $d_2$ nominal (internal pressure)

$d_{10}$ nominal = $d_1$ nominal (external pressure)

## 5. 'O' Ring Size Selection

**5.1** Tables 1 and 4 detail the range of component diameters within which each 'O' ring to IS : 9975 (Part 1)-1981 will operate within specific stretch (or compression) conditions

## 6. Design Criteria

**6.1** Housing dimensions have been derived from consideration of such design criteria as:

'O' ring stretch or compression cross section reduction,

'O' ring squeeze, and

'O' ring swell.

This Part deals with these criteria and indicates the maximum allowable limits within which they have been applied

### 6.2 'O' *Ring Stretch* (*or Compression*)

**6.2.1** *Piston housings* (*see Fig* 1)

Only stretch of an 'O' ring inside diameter has been permitted, that is, a clearance between $d_3$ and $d_1$ is not permitted.

Minimum stretch = 0
Thus, smallest permitted $d_3$ = $d_1$ *Max*
Maximum stretch = *X* percent (shown in Table 6)

$$= \frac{\text{Largest permitted } d_3 - d_1 \; Min}{d_1 \; Min} \times 100$$

or largest permitted $d_3 = d_1 \; Min \left(1 + \frac{X}{100}\right)$

TABLE 6 MAXIMUM STRETCH *X* PERCENT OF DIAMETER $d_1$

| Application | 'O' Ring Inside Diameter $d_1$ mm | | Maximum Stretch *X* Percent |
|---|---|---|---|
| | From | To | |
| Reciprocating and static | 8·00<br>14·0<br>40·0<br>100·0<br>206·0 | 13·2<br>38·7<br>97·5<br>200·0<br>250·0 | 8<br>6<br>5<br>4<br>3 |
| Static only | 258·0<br>412·0 | 400·0<br>670·0 | 3<br>2 |

**6.2.2** *Piston rod housing* (*see Fig.* 2)

Only compression of an 'O' ring outside diameter has been permitteed, that is, a clearance between $d_4$ and ($d_1$ + 2 $d_2$) is not permitted.

Minimum compression $= 0$

Thus largest permitted $d_6 = d_1\ Min + 2\ d_2\ Min$

Maximum compression $= Y$ percent ( shown in Table 7 )

$$= \frac{(d_1\ Max + 2\ d_2\ Max) - \text{smallest permitted } d_6}{(d_1\ Max + 2d_2\ Max)} \times 100$$

or smallest permitted $d_6 = (d_1\ Max + 2\ d_2\ Max)\left(1 - \frac{Y}{100}\right)$

TABLE 7 MAXIMUM COMPRESSION $Y$ PERCENT OF OUTSIDE DIAMETER ( $d_1 + 2d_2$ )

( *Clause* 6 2 2 )

| Application | 'O' Ring Inside Diameter $d_1$ mm | | *Max* Percentage Compression $Y$ |
|---|---|---|---|
| | From | To | |
| *Reciprocating and* static | 8 00 | 10 0 | 8 |
| | 10·60 | 25 0 | 6 |
| | 25 80 | 60 0 | 5 |
| | 61 50 | 125 0 | 4 |
| | 128 00 | 250 0 | 3 |
| Static only | 258 00 | 670 00 | 2 |

**6 3** *'O' Ring Cross Section Reduction*

**6.3 1** Where 'O' rings are stretched there is a reduction in cross section This can be calculated as follows

$$\text{Maximum reduction in cross section} = \frac{d_2\ Min}{10} \sqrt{\frac{6 + d_3\ Max - d_1\ Min}{d_1\ Min}}$$

**6.3.2** In Table 8 the maximum cross section reduction values are given for 'O' rings of standard cross section and diameter range specified in IS 9975 ( Part 1 )-1981

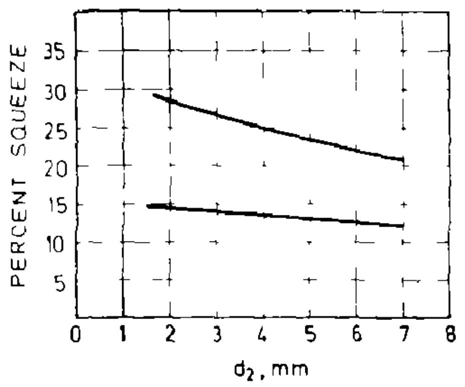
TABLE 8 MAXIMUM CROSS SECTION REDUCTION

All dimensions in millimetres

| 'O' Ring Cross Section Diameter $d_2$ | 'O' Ring Inside Diameter Range $d_1$ (mm) | | *Max* Cross Section Reduction |
|---|---|---|---|
| | From | To | |
| 1 80 | 8 0 | 13·2 | 0 119 |
| | 14 0 | 17 0 | 0 103 |
| 2 65 | 14·0 | 38 7 | 0·154 |
| 3 55 | 18·0 | 38·70 | 0·207 |
| | 40 0 | 97 50 | 0·189 |
| | 100 0 | 200 00 | 0 169 |
| 5 30 | 40 0 | 97 5 | 0 283 |
| | 100 0 | 200 0 | 0 253 |
| | 206 0 | 400·0 | 0 219 |
| 7·00 | 206·0 | 400 0 | 0·291 |
| | 412·0 | 670·0 | 0·237 |

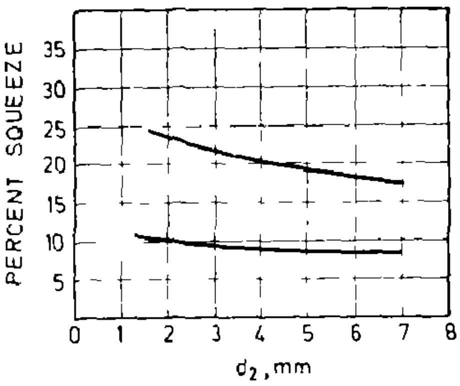
### 6.4 'O' Ring Squeeze

6.4.1 The graphs ( *see* Fig 4A, 4B and 4C ) show the minimum and maximum percentage squeeze values used to calculate housing depths $t_1$ and $t_2$ for diametral sealing and axial sealing


PISTON SEALING

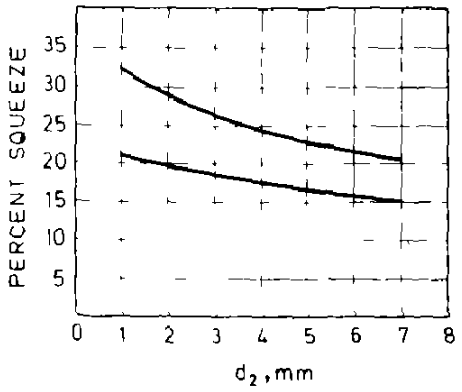
STATIC RADIAL

FIG 4A


PISTON ROD SEALING

STATIC RADIAL

FIG 4B


AXIAL SEALING

STATIC AXIAL

FIG 4C

6.4.2 These squeeze values compensate for stretch, cross section reduction, metal tolerances, and ensure adequate sealing under normal operating conditions However, there may be special applications where this squeeze should be increased or reduced by modifying the housing depth to achieve best sealing configuration which may be agreed to between the manufacturer and the user

### 6.5 'O' Ring Swell

6.5.1 Since 'O' ring materials may absorb some amount of fluid when subjected to contact with the fluid the compatibility will vary with different fluids Hence, the 'O' ring housing should be capable of absorbing the 'O' ring swell from the fluid and the 'O' ring expansion at increased temperatures

6.5.2 Therefore volumetric swell of 15 percent has been applied to the calculations to derive the housing width dimension $b_1$ and $b$

6.5.3 An 'O' ring material showing less swell is recommended for dynamic applications while volumetric swell of 15 percent should only occur in static applications

# APPENDIX A

( *Clause* 3.5 )

## CALCULATION OF HOUSING DIMENSIONS

**A-1.** The housing dimensions and component diameters for appropriate 'O' ring sizes to IS : 9975 ( Part 1 )-1981 can be taken direct from Tables 1, 2, 4 and 5. For sizes other than those specified in IS : 9975 ( Part 1 )-1981 the following calculation procedure may be adopted to find out the housing dimensions.

**A-2.** Piston rod sealing ( *see* Fig 2 ).

*Example*

Piston rod diameter $d_8$ = 100 mm

**A-2.1** Selection of 'O'-ring 53010000
( range 98·67 to 100·31 Refer Table 1 )

**A-2.2** Groove diameter $d_6$ minimum

$d_6$ *Min* = $d_8$ *Max* + 2 $t_1$ ( *see* 3.5 )
$d_8$ *Max* = 100·31 mm
$t_1$ = 4·36 mm
$d_6$ *Min* = 100·31 + 2 × (4·36)
= 109·03 mm

**A-2.3** Groove width $b_1$

$b_1 = 7{\cdot}1\ ^{+0{\cdot}25}_{\ 0}$ ( *see* Table 2 )

**A-3.** Piston sealing ( Fig. 1 )

*Example*

Bore diameter $d_1$ = 100 mm

**A-3.1** Selection of 'O'-ring 53008750
size range 97·14 to 99·37 ( *see* Table 1 )

**A-3.2** Groove diameter $d_4$ maximum

$d_4$ *Max* = $d_4$ *Min* − 2 $t_1$ ( *see* 3.5 )
$d_4$ *Min* = 97·14 mm
$t_1$ = 4·19 mm
$d_4$ *Max* = 97·14 − 2 × (4·19)
= 88·76 mm

**A-3.3** Groove width $b_1$

$b_1 = 7{\cdot}1\ ^{+0{\cdot}25}_{-0}$ ( *see* Table 2 )

Note — Where a choice of more than one cross section is available, it should be noted that larger cross sections are to be preferred, on grounds of reduced susceptibility to twist on assembly or during operation, on grounds of improved compression set resistance and better operation at low temperatures. Also, the 'O'-ring tolerances have lesser influence, the larger the cross sectional diameter.

# EXPLANATORY NOTE

This standard provides recommended design criteria and housing dimensions for 'O'-rings.

The conditions considered to formulate the design criteria are also described.

In preparation of this standard considerable assistance has been derived from the following sources:

1. ISO/DP 3601/II Fluid systems 'O'-rings, Part II Design criteria for standard applications International Organization for Standardization ( ISO ).
2. BS 1806 : 1962 Specification for dimensions of toroidal sealing: Rings ( 'O' seals and their housings ) British Standards Institution

This standard is the third in the series related to 'O'-rings. The other standards are:

Part 1 Dimensions
Part 2 Material — their selection and quality acceptance criteria
Part 3 Terminology and definitions of terms

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